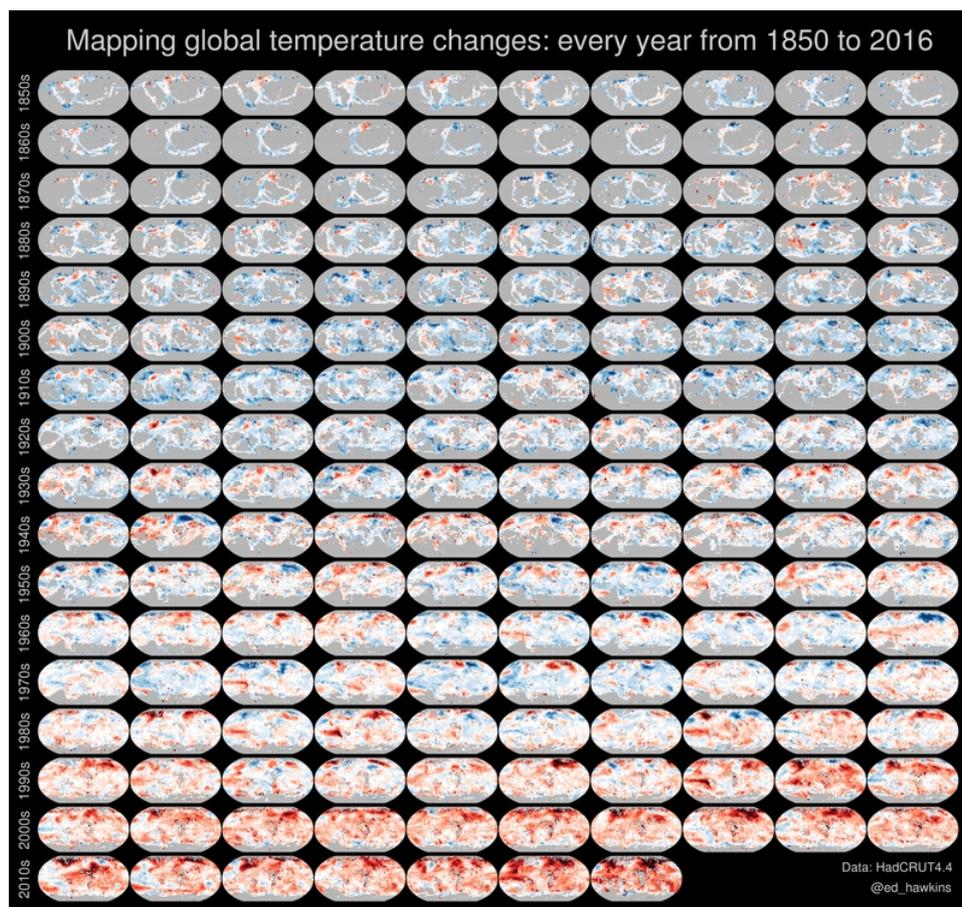




## Responsible Research and Innovation in Action

August 1, 2016. **Spinning off under RRI Principles: BioGAS+ by Applied Nanoparticles SL.**  
“The urgency in tackling climate change and promoting renewable sources of energy has been unanimously agreed globally by the UN General Assembly when adopting the New Sustainable Development Agenda (*Transforming our world: the 2030 Agenda for Sustainable Development*) and **it is the responsibility of all citizens, including the scientific and business communities.** Aligned with this broad framework, the EU is building a regulatory framework favouring the development of energy from renewable sources that, ideally, should be closely linked to increased energy efficiency and decentralized energy production.

Every molecule of CH<sub>4</sub> ends up being oxidized to CO<sub>2</sub> and a molecule of CH<sub>4</sub> causes up to 20 times more greenhouse effect than a molecule of CO<sub>2</sub>. From this perspective, **it is the responsibility of everyone, in order to create a cleaner planet with a more stable atmosphere, to prevent CH<sub>4</sub> from entering the atmosphere and rather to introduce it into our stoves, vehicles and heaters.**



Interestingly, in this context, in conditions of anaerobic breakdown, in the absence of oxygen, small doses of mixed iron oxide nanoparticles serve as a *catalyst* that stimulates bacteria metabolism and accelerates the production of biogas up to three times with cellulose as feedstock in laboratory

conditions (DIN-38414). Precisely, **the core project and main reason for setting up [Applied Nanoparticles SL](#) has been the commercial exploitation of a patent based on the use of engineered iron oxide nanoparticles for enhanced biogas production, named BioGAS+.**

**The Company started to work with [RRI principles](#)** when the main focus was on “emerging technologies” (nanotechnology, synthetic biology, geo-engineering, stem cell science, etc.), so potential controversial areas of research and innovation at an early stage of development, and where the day to day work on the lab was of paramount importance on the whole conceptual architecture. Within this framework (and considering that the majority of innovation in nanotechnology is based on University and Research Centres spin-off companies) it seems to be lacking effective policies for helping them to balance societal and economic considerations (because it is clear that nowadays, promotion outweighs precaution). Within these supporting policies, equal access to the marketplace is of paramount importance: as per today, to develop products under RRI require more time and economic resources (at least in the short term). This situation makes developments under RRI a voluntary and moral decision (as with [Corporate Social Responsibility –CSR-](#)) that will never have a real impact in changing current technoscience trajectories and, in the end, in global economic dynamics.

For these reasons, we do consider that **RRI have to be understood as a normative-political orientation that seeks to alter the present sociotechnical order**, so steeped in the philosophy of deliberative democracy and in social constructivist approaches of science.

**Turning to the daily work from the laboratory, our involvement with RRI can be summarized as follows: ... ” [Read more](#)**

context:

August 29, 2016. Interesting lessons for #RRI? **[The secret life of a corporate responsibility director: I point businesses towards their moral compass](#)**. “My job title sounds wishy-washy even to me – but it’s important to persuade companies to behave ethically. Which they will, if it makes them money (...) The hard truth is that businesses invariably want to explore any potential commercial benefit of more ethical operations.”

August, 2016. **[The Price Tag of Being Young: Climate Change and Millennials’ Economic Future](#)**. “Climate change is our nation’s greatest challenge. Left unaddressed, it will have devastating impacts on our economy, our environment, our communities, and on future generations. As a millennial, I know climate change will greatly affect my future. But until today, I didn’t know by how much.”

May 12, 2016. **[Power play: Envisioning a wind, water and solar world](#)** by Pat Brennan, NASA’s Jet Propulsion Laboratory. “Placing planet Earth on a strict diet—100 percent renewable energy—can be done by 2050, without the need for radically new technology.”

July 11, 2014. **[UN: Pathways to Deep Decarbonization](#)**. How to cut carbon emissions in order to prevent dangerous climate change. Biogas & Nanotechnology role.

## Exploring feedstocks for biogas production

August 27, 2016. **[Fuel Producing Toilet to be Exported to China](#)**. “A fuel producing toilet system developed by South Korea’s Ulsan National Institute of Science and Technology (UNIST) will be exported to China. The institute said Saturday that it recently signed a business agreement with a Chinese trade firm for the export of the eco-friendly toilets, as well as cooperation in bio-energy technologies. The toilet named BeeVi - short for “Toilet, like Bee with a Vision” - was first installed at the institute in May where excrement is decomposed to produce fuel. **It works by**

**transferring dried excrement from the toilet to a microbial response unit where the solid is converted into methane gas and carbon dioxide. Methane is used as fuel for heating while carbon dioxide is used to grow micro algae in order to produce biodiesel.** Those who use the toilet in this experiment are compensated with cyber money. Providing 200 grams of excrement earns 36-hundred won or about over three dollars. The cyber currency can be used at facilities within the institute's campus, such as cafes.”

August 24, 2016. **A 10-Foot-High Daisy May Be the Fuel of the Future** by Brian Parkin, Bloomberg. “A giant form of the flowering daisy plant that can grow 10 feet high **may become the favored fuel of Germany’s biogas industry.** The plant with small yellow flowers whose Latin name is Silphium Perfoliatum is known as Silphie in German. It’s sometimes called the Cup Plant or Indian Cup in the U.S., where it is native. Field experiments show it has advantages over maize, since it’s a perennial that comes up every year for two decades without replanting. The industry group representing 9,000 biogas plant owners in Germany said Silphie, which is in the same family as the daisy, **has the potential to reduce costs for green energy producers who now use maize** (...) “Maize is an extremely good resource, but people feel intimidated by this big plant -- it doesn’t help the image of the industry,” Andrea Horbelt, spokeswoman for the Biogas federation, said by phone from Freising, which is north of Munich. “Silphie is friendly, hardy, needs no chemical treatment, is ideal for bees. It’s probably as good for power generation.”



August 22, 2016. **La depuradora de Estiviel, puntera en el tratamiento de aguas residuales.** La OCU le otorga la máxima puntuación en separación de sólidos, eliminación de materia orgánica y disminución de nitrógeno y fósforo. “La EDAR cuenta con un moderno equipamiento para el **tratamiento de las aguas residuales y los fangos**, así como una línea de gas con aprovechamiento energético del biogás producido en el proceso de digestión del fango. Carlos Triviño ha destacado el tratamiento biológico que se realiza “mediante fangos activos con eliminación biológica de fósforo y nitrógeno”, aspecto éste destacado por el informe de la OCU.”

August 19, 2016. **These Torontonians are making the city a greener, more livable place** by Madeline Smith, The Globe and Mail. “Daniel Bida has spent the past five years advocating for what he calls a **“poo-to-power story.”** Mr. Bida, the executive director of the ZooShare Biogas Co-operative, is pushing forward plans to build a biogas plant across the street from the Toronto Zoo, where the **zoo’s manure and non-edible organic waste from a yet-undisclosed grocery chain will be processed.** As the waste breaks down in the plant, the resulting gas is captured and burned in an electrical generator, and Mr. Bida says the resulting output will be enough to power 250 homes. “As long as we as a society continue to produce organic waste, we can always make biogas and turn it into electricity or use it for another purpose,” he says. The Toronto Zoo first floated the idea for a biogas plant in 2003, but it wasn’t until 2010 that concrete plans started to

materialize. The ZooShare Biogas Co-operative spent 18 months selling community bonds for the initiative, ultimately raising more than \$2-million. They received renewable energy approval from the province and have construction plans this year. There are other biogas plants in Ontario, but Mr. Bida says none is centrally located in Toronto. **ZooShare says this will be North America's first zoo-based biogas plant**, and organizers hope its presence will encourage Torontonians to think about the impact of the every-day ways they take out their garbage. "If I tell you our emissions impact is taking the equivalent of 2,000 cars off the road, and collectively we need to remove more than a million, it doesn't really sound like very much," he says. "I like to subscribe to the theory that small is beautiful, and I think if we each do our part, each take these small steps one at a time, we can all collectively get there."



*Starting in August 2016, St. Louis-based Roeslein Alternative energy is set to distributing methane [from pig manure into a national pipeline system](#) at Ruckman Farm, near Albany, Missouri. Eventually, the project will be expanded to gather methane from the waste of about 2 million hogs spread across nine farms*

August 17, 2016. **Roeslein systems will turn hog manure into natural gas.** "St. Louis-based Roeslein Alternative Energy says it is providing the Smithfield Hog Production division of Smithfield Foods with a large-scale manure-to-energy system that will create biogas derived from hog manure lagoons. Roeslein and Smithfield are co-hosting an open house event on Aug. 24, 2016, to display what it calls "renewable natural gas (RNG) [that will be] produced from **the largest livestock manure-to-energy project of its kind**" that "will soon be delivering RNG into the national pipeline." The \$120 million project is being installed at several Smithfield Hog Production operations, including one near the town of Albany in northern Missouri, which will host the open house. The project's focus is to reduce greenhouse gas emissions, produce RNG, eliminate rainfall effects of treatment systems and generate additional jobs for the surrounding community, says Roeslein. Roeslein says impermeable synthetic covers are now installed on 41 of the 88 existing manure lagoons at nine Smithfield farms in Northern Missouri. The covers are designed to capture methane and turn the lagoons into anaerobic digesters where, as an interim step, the resulting biogas

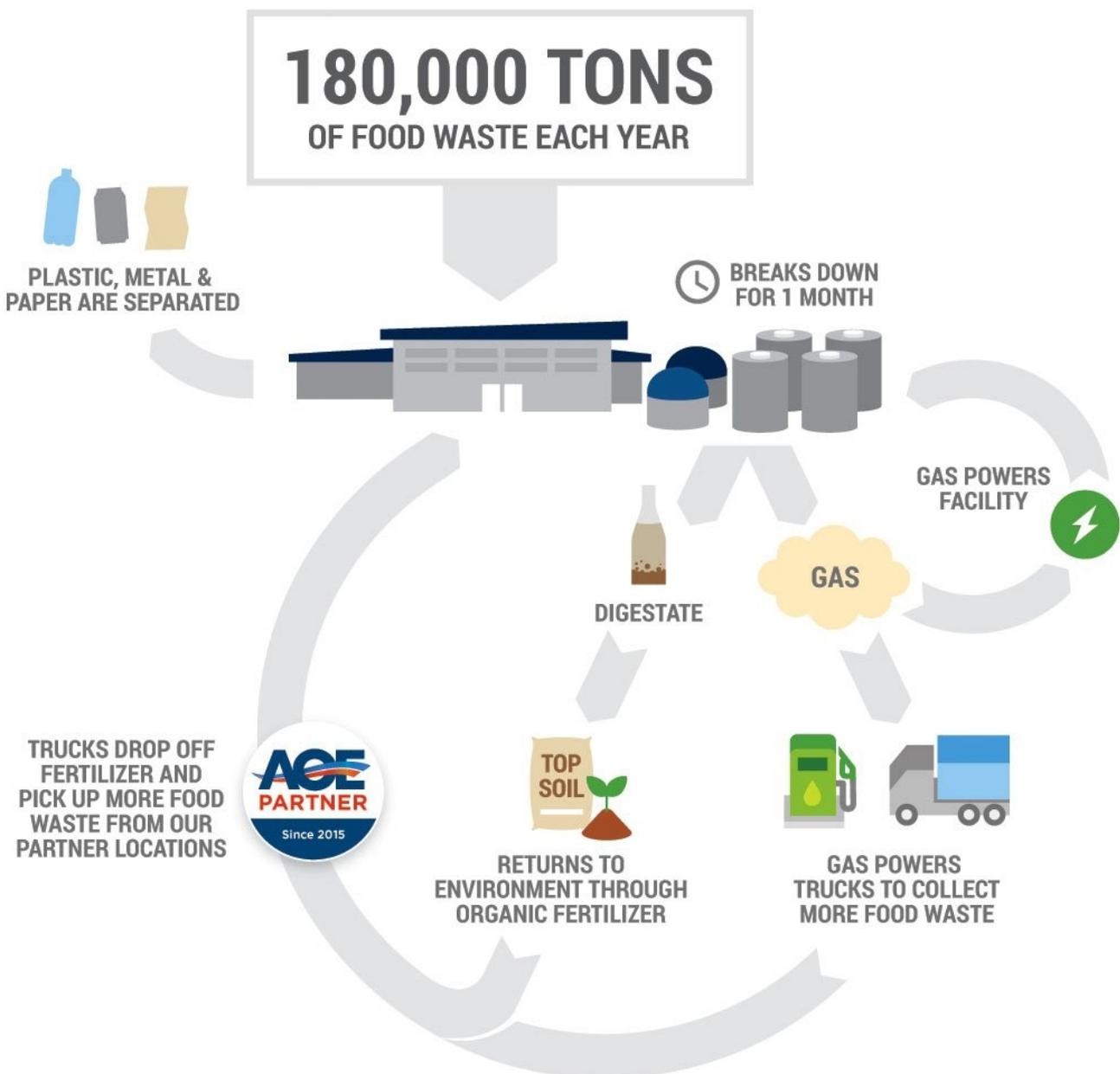
has been flared. Phase II of the project has involved installation of equipment to remove impurities from the biogas to create what Roeslein calls pipeline-quality RNG. As of July 1, **RNG from the anaerobic digestion of hog manure has been injected into the national pipeline** using an interconnect that was installed at Ruckman Farm. Duke Energy in North Carolina has agreed to purchase a portion of the RNG to help it meet clean energy requirements for power generation, according to Roeslein. When the project is finished, “several hundred million cubic feet of RNG will be available for similar transmission each year,” adds the company.” It will eventually harness **the waste of approximately 2 million pigs and is projected to be the largest biogas project in North America.**

August 16, 2016, **Excrementos de gallinas para construir una planta de biogás para el mayor productor de huevos en Colombia.** “WELTEC BIOPOWER iniciará en los próximos días la construcción de una planta de biogás para el mayor productor de huevos en Colombia: Incubadora Santander S.A. La planta de 800 kilovatios se conectará a la red de corriente eléctrica a principios de 2017. La compañía que diariamente produce aproximadamente 3,5 millones de huevos, le apuesta a la carga de sustratos por medio de la cofermentación de excrementos de gallina procedentes de las ponedoras y del agua utilizada durante el proceso de producción. Desde que el gobierno colombiano empezó a favorecer fiscalmente la generación de energías renovables mediante la Unidad de Planeación Minero Energética, UPME, la industria agraria ha descubierto un gran potencial en la biomasa. Hasta el momento, solo se ha convertido una escasa parte de la misma en energía verde. (...) Su proceso de producción **genera gran volumen de excrementos de gallina y de agua de servicio, con los que se puede operar la planta de biogás de 800 kilovatios de WELTEC BIOPOWER sin necesidad de comprar otros sustratos.**”

August 15, 2016. **Environmental life cycle assessment of biogas production from marine macroalgal feedstock for the substitution of energy crops.** “The central objective of this paper is to evaluate the production of biogas by the substitution of energy crops with marine macroalgae: a mixture of brown (20%) and red algae (80%) as feedstock in an industrial scale biogas plant. This plant operates with the co-digestion of maize (27%), grass (54%), rye (8%) and chicken manure (11) and produces 500 kWh energy. In order to assess environmental friendliness, a life cycle assessment was performed by using the software frame Simapro. Potential environmental impact categories under investigation were global warming, acidification, eutrophication and land transformation potential. **Our results determine the affirmative impact of the codigestion algae with chicken manure** on the emission reductions: 52%, 83%, 41% and 8% lower global warming, acidification, eutrophication and land transformation potentials, respectively per 1 MJ of energy generation, moreover, 84% and 6% lower acidification and land transformation potentials per kg of feedstock.”

August 8, 2016. **High-rate anaerobic co-digestion of kraft mill fibre sludge and activated sludge by CSTRs with sludge recirculation.** “Kraft fibre sludge from the pulp and paper industry constitutes a new, widely available substrate for the biogas production industry, with high methane potential.”

August 4, 2016. **American Organic Energy announces core engineering team for New York AD project.** “New York State called it “a significant step forward for the Long Island region in minimizing greenhouse gas emissions and reducing material going into landfills, providing economic and environmental benefits to its residents.” Adrienne Esposito, executive director of Citizens Campaign for the Environment, who has been instrumental in coordinating communication between AOE and community stakeholders, calls the digester a **“game-changer for solid waste on Long Island.”** Once fully operational, the facility will recycle food waste to produce vehicle fuel, electricity, compost and clean water, while reducing greenhouse gas emissions by 40,000 tons per year.”



*The proposed anaerobic digester project in the [Yaphank facility](#) (Long Island) will be the most sophisticated food waste processing facility in the world*

August 4, 2016. **Pre-treated pine needles produce more biogas, prevent forest fires.** “Pre-treatment of pine needles -- a common source of domestic fuel in the Indian Himalayas -- **with a microbial mix can enhance biogas production and help prevent forest fires**, scientists say. Pine needles are a difficult forest waste. They cannot serve as fodder and do not lend themselves to decay like other biomass and are a major source of wild forest fires as they are highly inflammable. “Additionally, dry pine foliage stops water from being absorbed by the soil and thus causes depletion of groundwater table. But they are a good source of biofuel and by harnessing them for sustainable energy, one can prevent forest fires” (...) To enhance utilisation of pine needles as a green energy source, the scientists deployed *Trichoderma* and *Pseudomonas* species. It was found that a biomethane yield of 21.3 litre/kg pine needles can be obtained from pretreated pine needles which was 300 per cent higher compared to untreated pine needles substrate (...) The present paper (co-authored by R. K. Dwivedi and TK Bhattacharya) is an outcome of a series of ongoing research involving variety of additives or treatment including other species of *Trichoderma*.”

August 3, 2016. **Medicine from waste?** by Ryland Cairns, Muntons. “Possible source for new antibiotic found in Muntons AD Plant Due to the widespread application of antibiotics in both human, and veterinary there is an increase in the presence and persistence of bacteria in the natural environment that are resistant to antibiotics. This is a growing health concern with recent reports concerning these so-called “superbugs”, so it is important to find new sources of antibiotics (...) **At Stowmarket based malt and malted ingredients producer Muntons we recognised that there could be potential to find some good bacteria due to their unique feedstock within their award winning anaerobic digestion plant.** “At Muntons we are committed to further advancing the knowledge surrounding the benefits of AD digestate. As such we are keen to get a better understanding of its composition whether this be related to nutrients, phytometabolites or in this particular case novel antibiotic producing bacteria. We were pleased to find out that **our AD plant appears to produce antibiotics that could potentially be developed as a medicine in the future** to combat Micrococcus and drug resistant E. coli. Due to the varying nature of AD plants and feedstock it would be great to know what is lurking inside other digesters.”

July 28, 2016. **Using grass as an AD feedstock - benefits for farmers and soils** by Gaynor Hartnell and Jeremy Dale, REA. “Using certain types of grass as a feedstock for AD plants brings significant benefits to UK soils and farming. We do not think that these should be subject to limited payments, as has been proposed for eg maize energy crops.”

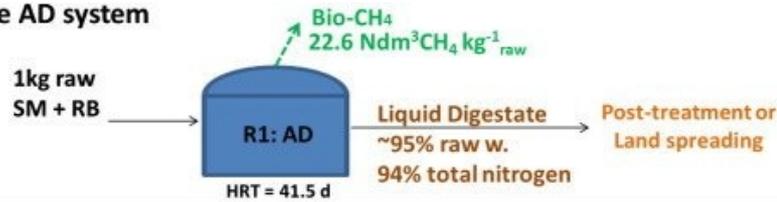
July 28, 2016. **Ductor® is opening a groundbreaking biotech plant in Haren, Germany.** “Ductor Corporation is announcing today that it will reach the goal of implementing its first commercial fermentation technology in Germany this autumn. The first implementation will be an application for the biogas producer in order **to significantly improve the economics of a biogas plant via replacing the expensive maize silage with inexpensive poultry manure.** As of September 2016, this biogas plant will start with Ductor® ammonia removal fermentation technology. Ductor’s technology harnesses the power of underutilized biomass with high nitrogen content such as poultry manure. ”With this technology, we are now solving the biggest problem for the biogas economy: high operating expense coming from expensive feedstock and the disposal cost of digest,” says Ari Ketola, CEO of Ductor. Ductor® fermentation technology extracts nitrogen at an early stage and prior to the biogas production process. It also simultaneously creates commercial by-products – ammonia or ammonium sulfate. Consequently, this process offers significant improvements to cost-effective biogas production. ”

July 19, 2016. **First Hungarian biogas plant utilising the waste materials of oyster mushroom production.** Under the slogan “Don’t waste your waste!” the INTERREG IVC project Waste 2 Energy (W2E) was, amongst other, looking for good practices on energy recovery techniques from waste and sustainable waste practices. One of the elected cases was the mushroom growing company Pilze-Nagy from Hungary. They created a great sideline to their normal daily business, namely an electric power plant fuelled by biogas. **The biogas is made from mushroom scraps and used growing substrate that produces remarkable green power.** It is estimated that in the course of mushroom growing, an annual quantity of approximately three thousand tons of exhausted substrate is produced. [Pilze-Nagy](#) aimed to find an economic and simultaneously environment-friendly solution and use for the huge amount of waste produced during the mushroom growing process. Finally, they decided for the application of the biogas technology. After positive results of the research and development work and a period, starting in June 2007, of initiating the project and constructing the biogas plant, the plant achieved its full capacity in October 2008.”

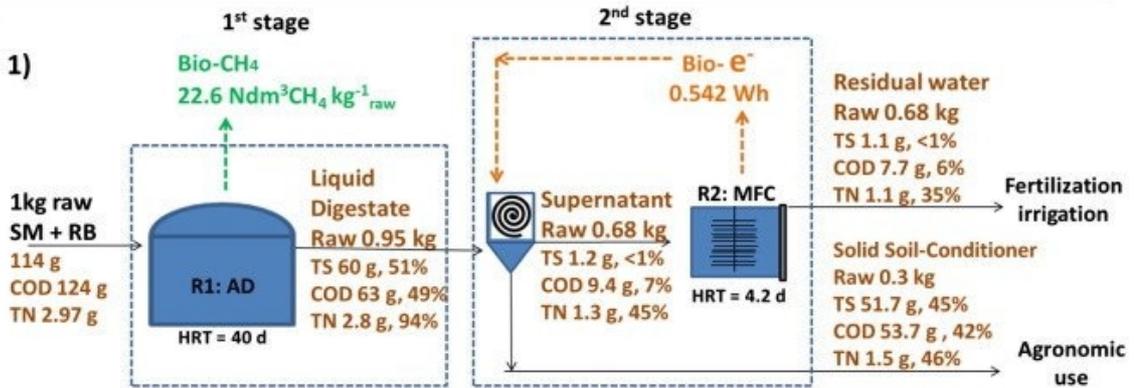
July 9, 2016. **Dark fermentation, anaerobic digestion and microbial fuel cells: An integrated system to valorize swine manure and rice bran.** “This work describes how dark fermentation (DF), anaerobic digestion (AD) and microbial fuel cells (MFC) and solid-liquid separation can be integrated to co-produce valuable biochemicals (hydrogen and methane), bioelectricity and

biofertilizers.”

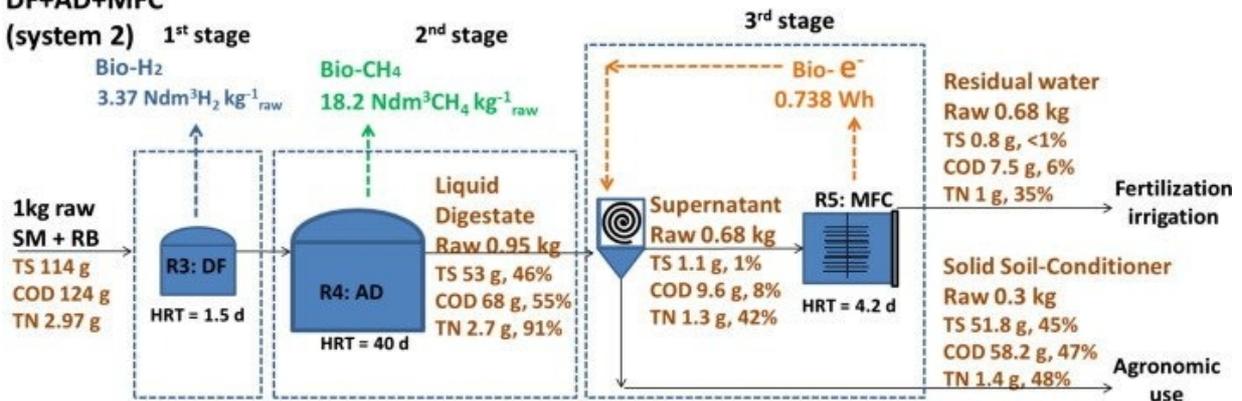
### Traditional one-stage AD system



### AD+MF (system 1)



### DF+AD+MFC (system 2)



## Growing awareness of biomethane as a substitute to conventional fuels

August 29, 2016. **Norwegian businesses will start using electric trucks.** “To date, the use of electric-powered trucks has been extremely limited. Now we see, however, that developments in cost, performance and charging time makes such vehicles considerably more interesting, says Head of Daimler Trucks and Buses, Wolfgang Bernhard (...) Nikola One is powered by six electric motors, one attached to each wheel. **The batteries are charged by a generator driven by biogas.** The consumption of biogas for charging is about third of consumption in a similar car powered by diesel.”

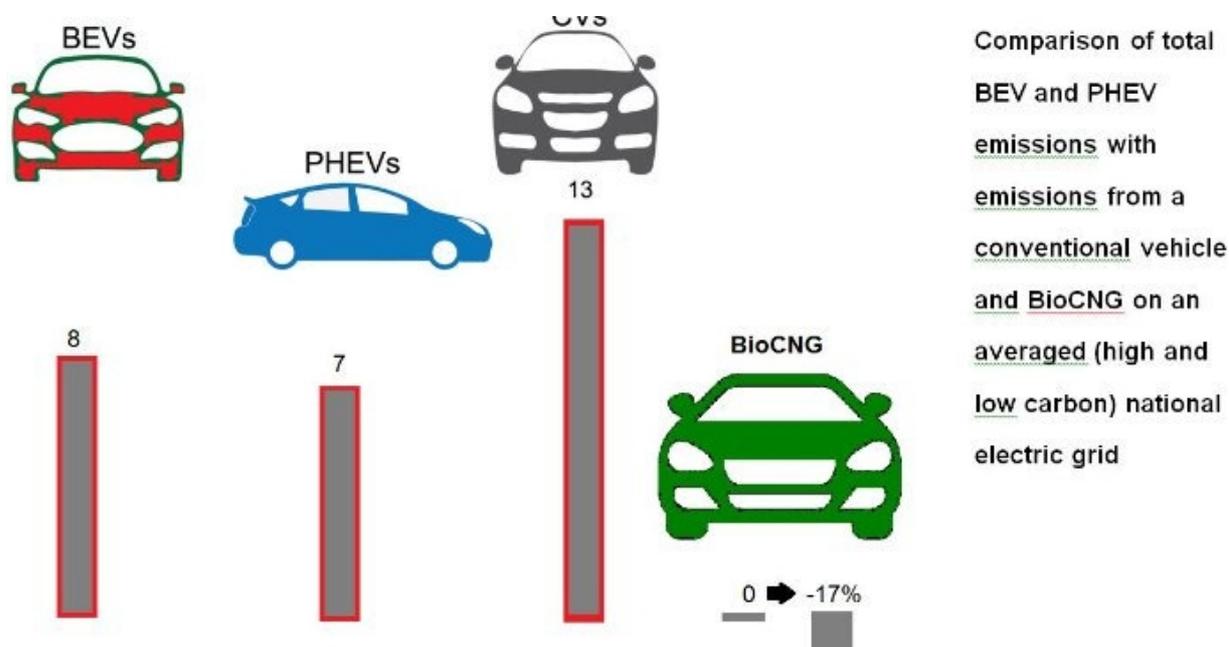
August 25, 2016. **Study Finds Biofuels Worse for Climate than Gasoline** by John Upton, Climate Central. “Years of number crunching that had seemed to corroborate the climate benefits of American biofuels were starkly challenged in a science journal on Thursday, with a team of scientists using a new approach to conclude that the climate would be better off without them. Based largely on comparisons of tailpipe pollution and crop growth linked to biofuels, University of Michigan Energy Institute scientists estimated that **powering an American vehicle with ethanol**

made from corn would have caused more carbon pollution than using gasoline during the eight years studied.”

August 24, 2016. **New US DOE, NREL report inadvertently highlights carbon emissions superiority of BioCNG vs Battery Electric and Plug-in Hybrid Electric Vehicles** by Brad Couch, Ariel. “In the recently released report entitled, "Emissions Associated with Electric Vehicle Charging: Impact of Electricity Generation Mix, Charging Infrastructure Availability, and Vehicle Type" the US DOE, NREL illustrates **the carbon neutral status of renewable fuels**. Then goes on to compare the overall emissions of compared vehicles. While the report is focused on showing the emissions benefits of BEVs and PHEVs from clean and dirty electric grids around North America when compared to a conventional gasoline burning vehicle, they also use data that shows the carbon neutrality of electricity produced by bioCNG (biomethane), the renewable, chemically identical substitute of fossil CNG (fossil methane aka shale gas or generically "natural gas", though technically, it is all natural gas) ... **For BioCNG enthusiasts, this carbon neutrality and even carbon gain, is an environmental homerun that even EV proponents can't claim.** BioCNG is environmentally a superior fuel to an EV charged from the grid and equivalent or slightly better than an EV charged by wind or solar.”

context:

August 8, 2016. **Transportation is now the biggest source of CO2 in the USA** by Lloyd Alter, Treehugger. “America passed an important milestone recently: the transportation sector now pumps out more carbon dioxide than the electric power generation sector (...) It is increasingly clear that there is no path to combating climate change that doesn't adequately address carbon pollution and other greenhouse gas emissions from transportation.”



August 19, 2016. **How Garbage Trucks Can Drive a Green Future** by Robert B. Catell and Joanna D. Underwood, The New York Times. “The city has done little about its heavy-duty vehicles, the largest source of fleet emissions. Its 5,200 heavy-duty diesel trucks account for only a fifth of the fleet, yet emit more than 60 percent of its greenhouse gas emissions. Because these trucks need higher power and torque than other types of fleet vehicles, the options for alternative fuels are limited. The city mandates blending the diesel fuel with 5 to 20 percent biodiesel, but that won't enable the de Blasio administration to reach its ambitious targets. **There is an alternative fuel that could: renewable natural gas.** Chemically, this substance is nearly identical to geologic natural gas, so trucks and buses equipped with natural gas engines can also run on renewable

natural gas. But it's not a fossil fuel like shale gas; it's a renewable, made from biogases emitted by decomposing organic waste, like wastewater or food waste — both things New York has plenty of. According to the California Air Resources Board, **renewable natural gas is the lowest-carbon fuel available. In fact, where food wastes are a major source, as they are in New York City, renewable natural gas can be carbon-free or even net carbon-negative over its life cycle.** This is because renewable natural gas captures powerful climate-warming gases like methane produced by decomposing organic matter, and prevents their escape into the atmosphere by burning them as fuel.”

August 15, 2016. **Electric Vehicle use is skyrocketing in China. That's terrible news** by Nathan Taft, Fuel Freedom Foundation. “As a foundation whose primary goal is ending our oil addiction both in the United States and internationally, you might think we'd be celebrating a rise in electric vehicle (EV) usage in the most populous country on Earth. And in some ways, we are. More EVs means fewer gas-guzzlers, and subsequently less money going to terrorist groups and oppressive regimes around the world. But because **China generates a whopping 72 percent of its electricity from coal**, it's not quite time to break out the party hats. Why? Because greenhouse gas (GHG) reductions from EVs powered by coal generated electricity are quite modest and actually **worsen air pollution by 2 to 5 times**. You think air quality in China is bad now? Just wait and see what it's like if EV proliferation continues at this rate and China doesn't clean up its electrical grid.”

**context:**

March 11, 2016. CO2 emissions for electric cars start at power grid: **Singapore taxes Tesla owner \$14,550 because his Model S is a 'high polluter'**. “Singapore appears to have been the only national regulator to have included power grid emissions in the rating of electric vehicles and that is the correct way to do it.”

August 11, 2016. **Da Gse ok a primo impianto agricolo per produzione biometano Cib, settore biogas pronto per trasformazione in carburante green**. “Il settore del biogas agricolo è pronto per l'evoluzione verso la produzione del biometano e il Gestore dei servizi energetici (Gse) è pronto a gestire questo passaggio: lo testimoniano la prima "qualifica a progetto" riconosciuta ad un impianto di produzione di biometano, del settore agricoltura, e tutte le attività poste in essere dal Gse che porteranno, in breve tempo, all'avvio del portale per la gestione informatizzata delle richieste di qualifica degli impianti a biometano. E' quanto emerso dall'incontro, oggi a Roma, tra Francesco Sperandini, presidente del Gse e Piero Gattoni, presidente del Consorzio Italiano Biogas (Cib). Il Gse, ricorda una nota, ha avviato il meccanismo di incentivazione per la produzione di biometano e l'8 agosto scorso ha accolto **la prima richiesta di qualifica a progetto di un impianto di produzione di biometano che, una volta entrato in esercizio, immetterà il bio-carburante direttamente nella rete del gas naturale, per il successivo utilizzo nel settore dei trasporti.**”

August 11, 2016. **Global Biomethane Market to Witness Substantial Growth Owing to Conducive Government Initiatives**. “Biomethane is methane obtained from biomass. It is a gas mixture with similar properties of natural gas and is stored deep inside the ground. Biomethane is considered as a pipeline quality of renewable natural gas, due to which it can be used as a substitute or can be blended with any conventional gas. The growing awareness regarding the benefits of biomethane has encouraged several companies to enter the global biomethane market (...) **What are the key factors that are influencing the demand for biomethane across the world? The growing awareness regarding the benefits of biomethane, especially as a substitute to conventional fuels**, has encouraged several industries to make use of biomethane for several operations. In addition, governmental policies in several regions are supportive of the grid injection system and are providing infrastructural and fiscal benefits to companies who are adopting these operations. The reduced need for fossil fuels, preservation of forests, reduced emission of greenhouse gases, and minimal exploitation of natural resources are some of the major benefits of biomethane. Thus, several players are expected to use biomethane at a large scale in the coming years, driving the overall market.”